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ODISHA ELECTRICITY REGULATORY COMMISSION

BIDYUT NIYAMAK BHAWAN

PLOT NO.4, OERC ROAD, SHAILASHREE VIHAR, BHUBANESWAR -751021

TEL. No. 2721048, 2721049

E-MAIL: oerc@odisha.gov.in / orierc@gmail.com

WEBSITE: www.orierc.org

NOTIFICATION

The 1st January 2025

No. 10—DIR(T)-421/2024—In exercise of the powers conferred under Section 181 of the Electricity Act, 2003 (36 of 2003), read with Sections 61, 66, and 86 thereof and all other powers enabling it in this behalf, the Odisha Electricity Regulatory Commission hereby makes the following Regulations to establish a Resource Adequacy framework for planning of generation resources and power procurement with an optimum generation mix.

Chapter 1

Preliminary

1. Short Title, Extent and Commencement

- 1.1. These Regulations shall be called the “Odisha Electricity Regulatory Commission (Framework for Resource Adequacy) Regulations, 2024”.
- 1.2. These Regulations shall be read in conjunction with “Guidelines for Resource Adequacy Planning Framework for India” as issued by Government of India from time to time.
- 1.3. These Regulations shall extend to the whole state of Odisha.
- 1.4. These Regulations shall come into force from the date of their notification in the Official Gazette.

2. Objective

- 2.1. The objective of these Regulations is to enable the implementation of Resource Adequacy framework by outlining a mechanism for planning of generation resources to reliably serve the projected demand with an optimum generation mix in a cost-effective manner, ensuring a reliable operation of the power system under various scenarios.
- 2.2. The Resource Adequacy framework shall cover a mechanism for demand assessment and forecasting, generation resource planning, procurement planning, monitoring and compliance.

3. Scope and Applicability

- 3.1. These Regulations shall apply to the GRIDCO, Distribution Licensees, Generating Companies, State Load Despatch Centre, State Transmission Utility and other grid connected entities and stakeholders within the state of Odisha.

4. Definitions

- 4.1. In these Regulations, unless the context otherwise requires,
 - a. “**Act**” means the Electricity Act, 2003 (36 of 2003) and subsequent amendments thereof.
 - b. “**Authority**” means Central Electricity Authority referred to in sub-section (1) of Section 70 of the Act.
 - c. “**Capacity**” means the installed nameplate capacity of the resource.
 - d. “**Capacity Credit**” or “**CC**” means the firm capacity expressed as a percentage of a installed nameplate capacity that is considered for calculation of firm capacity to meet Resource Adequacy Requirements.
 - e. “**Commission**” or “**State Commission**” means the Odisha Electricity Regulatory Commission (OERC) constituted under the Act.
 - f. “**Consumer**” means any person who is supplied with electricity for his/her own use by a licensee/ supplier or the Government or by any other person engaged in the business of supplying electricity to the public under the Act or any other law for the time being in force and includes any person whose premises are for the time being connected for the purpose of receiving electricity with the works of a licensee/ supplier, the Government or such other person, as the case may be.
 - g. “**Distribution Licensee**” means a person granted license under the Act to operate and maintain a distribution system and to supply electricity to the consumers in his area of supply.

- h. **“Electric Power Survey”** or **“EPS”** means a periodic electric power survey conducted by the Central Electricity Authority to assess the electricity demand on Medium and Long-Term basis for each DISCOM/State/Union Territory/Region and for the country.
- i. **“Expected Energy Not Served”** or **“EENS”** means the expected amount of energy (MWh) that may not be served for each year within the time horizon for Resource Adequacy planning.
- j. **“GRIDCO”** means GRIDCO Limited which is the “State Designated Entity” to sign Power Purchase Agreements (PPAs) with the developer(s) for procurement of power from different sources to meet the state demand, involved in business of bulk purchase and bulk sale of power to the four Distribution Companies inside the state and trading of surplus power through traders;
- k. **“Load Factor”** is calculated by dividing total electrical energy requirement for a given period of time by the product of maximum demand and that specific period of time. The formulae for calculating load factor on monthly and yearly basis are:

Monthly Load Factor (in %)

$$= \frac{(\text{Energy Requirement in MU} * 100)}{(\text{Peak Demand in MW} * \text{No. of days in the Month} * \text{No. of hours in a day})}$$

Yearly Load Factor (in %)

$$= \frac{(\text{Energy Requirement in MU} * 100)}{(\text{Peak Demand in MW} * \text{No. of days in the year} * \text{No. of hours in a day})}$$

- l. **“Load Diversity Factor”** means the ratio of the sum of individual non-coincident maximum loads of Divisions to the Maximum Demand of the DISCOM’s operational area.

Load Diversity Factor

$$= \frac{\sum_{i=1}^n (\text{Individual non_coincident maximum loads of Divisions})}{\text{Maximum Demand of the DISCOM's Operational area}}$$

Load Diversity Factor is always greater than 1.

- m. **“Long Term”** means ten years for development of demand forecast, generation resource plan and procurement plan.

- n. **“Loss of Load Probability”** or **“LOLP”** means probability that a system’s load will exceed the generation and firm power contracts available to meet that load in a year.
- o. **“Long-Term Distribution Resource Adequacy Plan”** or **“LT-DRAP”** means plan for assessment of Long-term resource adequacy by GRIDCO.
- p. **“Long-Term National Resource Adequacy Plan”** or **“LT-NRAP”** means plan for national level assessment of Long-Term resource adequacy published by Central Electricity Authority as per RA Guidelines.
- q. **“Medium Term”** means duration exceeding one year and upto five years for development of demand forecast, generation resource plan, and procurement plan.
- r. **“Medium-Term Distribution Resource Adequacy Plan”** or **“MT-DRAP”** means plan for assessment of Medium-Term resource adequacy by GRIDCO.
- s. **“Net Load”** means the load derived upon exclusion of actual generation (MW) from renewable energy generation resources from gross load prevalent on the Grid during any time-block.
- t. **“Normalized Energy Not Served”** or **“NENS”** is the total expected load shed due to supply shortage (MWh) as a percentage (%) of the total system energy, and therefore represents an overall percentage of system load that cannot be served.
- u. **“Planning Reserve Margin”** or **“PRM”** means a specified percentage of peak load forecast of the system as may be stipulated by the Authority for the purpose of generation resource planning to address the demand and supply variation ensuring adequacy of generation resources in the system.
- v. **“RA Guidelines”** means Guidelines for Resource Adequacy planning framework for India notified by Ministry of Power in consultation with Central Electricity Authority framed under Rule 16 of Electricity (Amendment) Rules, 2022 and subsequent amendments in the guidelines issue from time to time.
- w. **“Reliability Indices”** means a set of metrics for evaluation of the reliability of electrical power system. For the context of these regulations, Reliability Indices shall be in terms of LOLP and NENS.
- x. **“Resource Adequacy”** or **“RA”** means a mechanism to ensure adequate supply of generation to serve expected demand (including peak, off peak and in all operating conditions) reliably in compliance with specified reliability standards for serving the load with an optimum generation mix with a focus on integration of environmentally benign technologies after taking into account the need, inter alia, for flexible resources, storage

systems for energy shift, and demand response measures for managing the intermittency and variability of renewable energy sources.

- y. **“Short Term”** means one year for development of demand forecast, generation resource plan, and procurement plan.
- z. **“Short-Term Distribution Resource Adequacy Plan”** or **“ST-DRAP”** means plan for assessment of Short-Term resource adequacy by GRIDCO.
- aa. **“State Load Despatch Centre”** or **“SLDC”** means the Centre established under sub-section (1) of Section 31 of the Act;
- bb. **“State Transmission Utility (STU)”** means the Odisha Power Transmission Corporation Limited or any such utility declared by the State Government engaged in the transmission of electricity within the state.
- cc. **“Time-Block”** means a time block of 15 minutes, or any such shorter duration as may be notified by Central Commission or State Commission, for which specified electrical parameters and quantities are recorded by Special Energy Meter (SEM), with first time block starting at 00:00 hrs.
- dd. **“Vesting Order(s)”** means the Order(s) issued by the Commission with respect to sale of erstwhile Distribution Utilities under Section 20 of the Electricity Act 2003 and for vesting of Utility to the intending purchaser under Section 21 of the said Act.
- ee. **“Year”** means financial year commencing on 1st April of the year and ending on 31st March of the succeeding year.

4.2. All other words and expressions used in these Regulations, although not specifically defined herein above, but defined in the Act or in any other Regulations issued by the Central Commission or State Commission, shall have the same meaning assigned to them as in the Act or any other Regulations issues by the Central Commission or State Commission.

Chapter 2

General

5. Resource Adequacy Framework

5.1. Resource Adequacy framework entails the planning of generation resources for reliably meeting the projected demand in compliance with specified reliability standards for serving the load with an optimum generation mix.

5.2. Resource Adequacy framework shall cover following important steps:

- a) Demand assessment and forecasting
 - b) Generation resource planning
 - c) Procurement planning
 - d) Monitoring and compliance
- 5.3. The Long, Medium and Short Term for the purpose of these Regulations shall be considered as:
- a) Long-Term procurement plan for a period up to ten years; and
 - b) Medium-Term procurement plan for a period up to five years; and
 - c) Short-Term procurement plan for a period up to one year.
- 5.4. The Resource Adequacy exercise shall be developed and prepared for a planning period of 10 (Ten) years on annual rolling basis.
- 5.5. The Distribution Licensee shall assess and prepare demand forecasts and GRDICO shall develop and prepare Medium-Term Distribution Resource Adequacy Plan (MT-DRAP) and Short-Term Distribution Resource Adequacy Plan (ST-DRAP) in accordance with the conditions outlined under these Regulations.
- 5.6. GRIDCO shall undertake Long-Term Distribution Resource Adequacy Plan (LT-DRAP) to meet peak demand and electrical energy requirement as per RA Guidelines and other amendments/ guidelines issued by the Authority in this regard.

Chapter 3

Demand Assessment and Forecasting

6. Long-Term and Medium-Term Demand Forecast

- 6.1. Demand assessment and forecasting is an important step for Resource Adequacy assessment. It shall entail monthly assessment and forecasting of demand within the distribution area of the Distribution Licensee for multiple horizons (Short/Medium/Long-Term) using comprehensive input data, policies, drivers and scientific mathematical modelling tools.
- 6.2. The Distribution Licensee shall be responsible for the assessment and forecasting of demand (MW) and energy requirement (MWh) within its own control area.
- 6.3. The Distribution Licensee shall determine the load forecast for voltage wise consumption such as LT, HT and EHT. Further, the data should be supplemented with consumption breakup under 11 consumer categories (Domestic, Commercial, Public lighting, Public water works, Irrigation, LT industries, HT industries, Railway traction, Bulk supply, Open Access and others) for which the Commission has determined separate retail tariff.

- 6.4. The Distribution Licensee shall determine the load forecast for a customer category by adopting any of the following and/or combination of following methodologies:
- a) Compounded Average Growth Rate (CAGR);
 - b) End use or partial end use;
 - c) Trend Analysis;
 - d) Auto-Regressive Integrated Moving Average (ARIMA);
 - e) Artificial Intelligence (AI) including machine learning, Artificial Neural Networks (ANN) techniques; and
 - f) Econometric Modelling (specifying the parameters used, algorithm, and source of data).
- 6.5. The Distribution Licensee may use Electric Power Survey (EPS) projections as base and/or any other methodologies other than the above-mentioned after recording the merits of the method. Further, Distribution Licensee should use best fit of various methodologies for the purpose of demand/load forecast taking into consideration probabilistic modelling approach for various scenarios (viz. most probable, business as usual, aggressive) as per these Regulations.
- 6.6. For the purposes of deciding the load forecast for a customer category and the methodology to be used for load forecasting of a customer category, the Distribution Licensee must conduct statistical analysis and shall select the method for which standard deviation is lowest and R-square is highest.
- 6.7. The Distribution Licensee shall utilize state-of-the-art tools, scientific and mathematical methodologies, and comprehensive database such as but not limited to weather data, historical data, demographic and econometric data, consumption profiles, impact of policies and drivers etc. as may be applicable to their control area.
- 6.8. The Distribution Licensee may modify the load obtained on either side, for each customer category segregating voltage wise, by considering the impact of each but not limited to the following activities. The impact shall be considered by developing trajectories for each of the activities based on the economic parameters, policies, historical data, and projections for the future.
- a) Demand-Side Management (for short term forecast only);
 - b) Open Access;
 - c) Distributed Energy Resources (DERs);
 - d) Demand response measures & ToD Tariff;
 - e) Electric Vehicles and EV Charging Stations;
 - f) Tariff Signals;
 - g) Changes in specific energy consumption,
 - h) Increase in commercial activities with electrification
 - i) Increase in number of agricultural pump sets and its solarization

- j) Changes in consumption pattern for seasonal consumers
- k) Availability of supply
- l) Energy Storage System (ESS) e.g. Battery ESS, Pumped Storage System etc.; and
- m) Policy influences such as 24X7 supply to all customers, LED penetration, efficient use of fans/appliances, increased use of appliances for cooking/heating applications, electrification policies, distributive energy resources, storage, and policies, which can impact econometric parameters, impact of national hydrogen mission. For each policy, a separate trajectory should be developed for each customer category.

- 6.9. The Distribution Licensee may take into consideration any other factor not mentioned in clause 6.8 after recording the merits of its consideration.
- 6.10. The Long-Term and Medium-Term load profile of the customer categories segregating voltage wise for which load research has been conducted may be refined on the basis of load research analysis using Smart Meter Infrastructure. A detailed explanation for refinement conducted must be provided.
- 6.11. The summation of energy forecast (MWh) for various consumer categories segregating voltage wise, upon adjusting for captive, prosumer, and open access load forecast, as obtained as per clauses 6.4 to clause 6.10, as the case may be, shall form the basis of load forecast (MW) for the Distribution Licensee.
- 6.12. The Distribution Licensee shall calculate the energy forecasts (in MWh) by adding distribution loss as per the AT&C loss trajectory approved by the Commission in the Vesting Orders by considering Collection efficiency as 99%. In the absence of the loss trajectory as approved by the Commission for the planning horizon, an appropriate loss trajectory stipulated by State or National policies shall be considered with a detailed explanation.
- 6.13. The peak demand (in MW) shall be determined by considering the average load factor, for the last three years and the energy forecasts (in MWh) obtained in clause 6.12. If any other appropriate load factor is considered for future years, a detailed explanation shall be provided.
- 6.14. The Distribution Licensee shall conduct sensitivity and probability analysis to determine the most probable demand forecast. The Distribution Licensee must also develop Long-Term and Medium-Term demand forecasts for possible scenarios, while ensuring that at least three different scenarios (most probable, business as usual, and aggressive scenarios) are developed. The Distribution Licensee, for the purpose of demand forecast may also follow CEA guidelines for Long-Term and Medium-Term Power Demand Forecast issued from time to time.
- 6.15 The Distribution Licensee shall maintain the database of actual energy consumption in its area of operation, block-wise/hourly/monthly for all consumer categories segregating

voltage wise, depending on the availability of requisite infrastructure, which shall form the basis for future demand forecasting for intervals/periods as notified by the Commission from time to time.

7. Short Term Demand Forecast and Aggregation at State

A. Short Term Demand Forecast

- 7.1. The Distribution Licensee shall develop a methodology for monthly demand forecasting and shall maintain a historical database.
- 7.2. For the purpose of ascertaining monthly load profile and for assessment of contribution of various customer categories segregating voltage wise to peak demand, load research analysis shall be conducted and influence of demand response, load shift measures, time of use shall be factored in by Distribution Licensee with inputs from State Load Despatch Centre (SLDC). A detailed explanation for refinement conducted must be provided.
- 7.3. The Distribution Licensee shall utilize state-of-the-art tools, scientific & mathematical methodologies and comprehensive data but not limited to weather data, historical data, demographic and econometric data, consumption profiles, policies and drivers etc. as may be applicable to their control area.

B. Aggregation of Demand Forecast

- 7.4. The Distribution Licensee shall produce monthly 1-year Short-Term (ST), 5-year Medium-Term (MT) and 10-years Long-Term (LT) forecasts on a rolling basis and submit to SLDC by 30th April of each year for the ensuing year(s).
- 7.5. SLDC shall aggregate the demand forecasted by Distribution Licensees, duly considering the diversity of the state, congruency, seasonal variation aspects and shall prepare the monthly 1-year Short-Term (ST), 5-year Medium-Term (MT) and 10-years Long-Term (LT) forecasts for the entire state after considering the Intra state transmission loss as approved by the Commission in the Business Plan of the STU from time to time and the transmission loss figure available for the last year of the Business plan shall be considered for assessment of demand for the future years.
- 7.6. SLDC shall submit the state-level aggregate demand forecasts (MW and MWh) for Long-Term, Medium-Term and Short-Term to the Authority, NLDC, ERLDC, GRIDCO and STU by 31st May of each year for the ensuing year(s).
- 7.7. GRIDCO with inputs from SLDC and based on the demand estimates of the Distribution Licensees of the State, shall estimate in different time horizons, namely Long-Term, Medium-Term and Short-Term, the demand for the entire State.

Chapter 4

Generation Resource Planning

8. Generation resource assessment and planning is the second step after demand assessment and forecasting. GRIDCO shall plan and assess the existing and contracted resources considering their Capacity Credit and identification of incremental capacity requirement to meet forecasted demand including Planning Reserve Margin.

9. Key contours and important steps in Generation Resource Planning:

9.1. Generation resource planning shall entail the following steps namely,

- (a) Capacity crediting of generation resources,
- (b) Assessment of Planning Reserve Margin, and
- (c) Ascertaining resource adequacy requirement and allocation for obligated entities within the state.

9.2. GRIDCO shall map all its contracted existing resources, upcoming resources and retiring resources to develop the existing resource map in MW for Long-Term and Medium-Term power procurement plan.

9.3. The mapping shall include critical characteristics and parameters of the generating machines, such as heat rate, auxiliary consumption, ramp-up rate, ramp-down rate, etc., for thermal machines; hydrology and machine characteristics etc. for hydro machines; and renewable resources, their Capacity factors/CUFs, etc. for renewable resource-based power plants to be considered in the resource plan. All the characteristics and parameters for each generating machine considered shall be provided in the resource plan. Some of the important parameters that would be considered for this resource characteristic assessment shall include but not limited to following:

- a) Name of the plant (with location, district, taluka, geo-coordinates)
- b) Installed Plant Capacity (MW) (existing and planned)
- c) Heat rate of thermal generating stations A
- d) Auxiliary consumption (MW)
- e) Maximum and Minimum generation limits (MW)
- f) Ramp up and Ramp down rate (MW/min)
- g) Minimum up and down time
- h) Plant availability factor (%)
- i) Average capacity utilisation factor for past 3 years (%)
- j) Historical forced outage rates
- k) Installed Capacity and generation profile of renewable energy generation resources
- l) Under-construction / contracted capacity with likely date of commissioning
- m) Planned Retirement of capacity or Renovation of capacity with timelines
- n) Transmission expansion plans with timelines

- o) Evacuation arrangements with timelines for RE generation resources
- p) Effective head (head race level-tail race level) for actual delivery of hydro plants

9.4. Constraints such as penalties for unmet demand, forced outages, spinning reserve requirements, and system emission limits as defined in State and Central electricity grid codes and emission norms specified by the Ministry of Environment and Forest shall be identified and enlisted.

9.5. GRIDCO shall also include a Planning Reserve Margin (PRM) as specified by the Authority or Commission, as the case may be. In the absence of any guidelines from the Commission, GRIDCO can consider suitable Planning Reserve Margin (PRM). The planning reserve considered shall be stipulated in the resource plan along with justifications.

10. Capacity Crediting of Generation Resources

10.1. GRIDCO shall compute Capacity Credit (CC) factors for their contracted generation resources by applying the net load-based approach as outlined under Clause 10.2 of this Regulation. The five-year average of the Capacity Credit (CC) factor for each type of the contracted generation resource for the recent five years on a rolling basis shall be considered as Capacity Credit factor for the purpose of generation resource planning.

10.2. The Net Load based approach/methodology for determination of Capacity Credit (CC) factors for generation resources (including wind and solar) shall be adopted as under:

- a) For each year, the hourly recorded Gross Load for 8760 hours/ 8784 hours for leap year (or time-block) shall be arranged in descending order.
- b) For each hour, the Net Load is calculated by subtracting the actual wind or solar generation corresponding to that load for 8760 hours/ 8784 hours for leap year (or time-block) and then arranged in descending order similar to Step 1.
- c) The difference between these two load duration curves represents the contribution of capacity factor of wind generation or solar generation, as the case may be.
- d) Installed capacity of wind or solar generation capacity is summed up corresponding to the top 250 load hours.
- e) Total generation from wind or solar generation corresponding to these top 250 hours is summed up.
- f) Resultant CC factor is (Total Generation for top load 250 hours)/(Installed RE Capacity for top load 250 hours), as per formula below:

$$\text{CC factor} = \frac{(\text{Sum of RE Generation for top } x \text{ hours})}{(\text{Sum of RE Capacity for top } x \text{ hours})}$$

- g) The process for CC factor determination shall be undertaken for each year for duration of past five-years and the resultant CC is the average of CC values of past 5 years.

Provided that at the time of determining CC factor considering past five years duration values, GRIDCO shall exclude abnormal values during the year for following events or circumstances, but not limited to:

- (i) Act of God including but not limited to lightning, drought, fire and explosion, earthquake, volcanic eruption, landslide, flood, cyclone, typhoon, tornado, geological surprises, natural disasters or exceptionally adverse weather conditions, which are in excess of the statistical measures for the last hundred years; or
- (ii) Any disaster declared as such by the Central Government under Disaster Management Act, as amended from time to time; or
- (iii) Any act of war, invasion, armed conflict or act of a foreign enemy, blockade, embargo, revolution, riot, insurrection, terrorist or military action.

10.3. For the purpose of Inter-state contracted RE generation or intra-state RE resources, contribution of CC factor for the RE or generation resource where such resource is located in the grid (viz. inter-state or intra-state, as the case may be) as contracted by GRIDCO shall be considered. For this purpose, CC factors as specified by Authority or as approved by the Commission shall be considered.

10.4. CC factors for hydro generation resources shall be computed based on water availability with different CC factors for run-of-the-river hydro power projects and dam-based/storage-based hydro power projects.

10.5. CC for thermal resources shall be computed based on coal availability and forced outages.

10.6. GRIDCO shall share CC factors for their contracted resources along with justification for its computations with SLDC by 15th May of each year for ensuing year(s).

10.7. SLDC shall calculate state-specific CC factors considering the aggregate State Demand and State Net Load and contracted RE generation resources available in the State and shall submit such CC factor information to the Authority, NLDC and ERLDC by 31st May of each year for ensuing year(s).

11. Assessment of Planning Reserve Margin (PRM)

11.1. Planning Reserve Margin (PRM) as a percentage of peak load represents the excess generation resource or planning reserve required to be considered for the purpose of generation resource planning.

- 11.2. Such Planning Reserve Margin (PRM) factor (for example, 7%) shall be based on the reliability indices in terms of Loss of Load Probability (LOLP, for example, 0.2%) and Normalized Energy Not Served (NENS, for example, 0.05%) as may be specified by the Authority
- 11.3. The PRM determined under Regulation 11.1 and 11.2 of these Regulations shall be considered by GRIDCO in their planning for resource adequacy requirement and generation resource capacity planning.
- 11.4. The capacity planning by GRIDCO and State level resource adequacy planning by STU/SLDC shall factor in PRM while developing state-level Integrated Resource Plan.

12. Resource Adequacy Requirement and its Allocation

- 12.1. GRIDCO shall determine capacity requirement to meet demand and PRM considering available capacity adjusted for capacity crediting for existing and planned contracted generation resources. The available capacity as determined shall be then plotted over a time axis of 15-minute intervals or longer, but not more than one hour. This shall form the resource map of GRIDCO.
- 12.2. GRIDCO shall subtract the resource map developed in clause 12.1 from the demand forecast submitted to GRIDCO by SLDC as per regulation 7.6, to identify the resource gap. The resource gap in terms of RA compliance for Long-Term and Medium-Term shall be developed in the manner as specified in these Regulations.
- 12.3. GRIDCO shall conduct sensitivity and probability analysis to determine the most probable resource gap. It shall also develop Long-Term, Medium-Term and Short-Term resource gap plans for possible scenarios, while ensuring that at least three different scenarios (most probable, business as usual, and aggressive) are developed.
- 12.4. Based on most probable scenario, GRIDCO shall undertake development of Medium-term Distribution Resource Adequacy Plan (MT-DRAP) and Short-Term Distribution Resource Adequacy Plan (ST-DRAP) exercise to meet RA target requirement. GRIDCO shall submit the RA plans, i.e. MT-DRAP and ST-DRAP to the Commission by 31st August of each year for Commission's approval. GRIDCO shall also submit the RA Plans to the STU and SLDC for further examination so as to appraise the Commission as per Regulation 19.1 of these Regulations.
- 12.5. Long-Term National Resource Adequacy Plan (LT-NRAP) and Short-Term National Resource Adequacy Plan (ST-NRAP) reports shall act as guidance for GRIDCO for undertaking the Resource Adequacy exercises.
- 12.6. Long-Term National Resource Adequacy Plan (LT-NRAP) report published by the Central Electricity Authority each year for ensuing year(s) includes the optimal generation mix for the next 10 years ensuring compliance with Resource Adequacy

Requirements while meeting All-India/ national demand at least cost basis, optimal Planning Reserve Margin (PRM) requirement at All-India/ National level for ensuring reliable supply targets, Capacity Credits for different resource types on a regional basis and prescribe the State contribution towards the national peak demand.

12.7. One-year look-ahead Short-Term National Resource Adequacy Plan (ST-NRAP) report published by NLDC each year for ensuing year includes parameters such as demand forecasts, resource availability based on under-construction status of new projects, planned maintenance schedules of existing stations, station-wise historic forced outage rates and decommissioning plans.

12.8. RA requirement planning shall be done with reference to national coincident peak to optimize requirement of incremental capacity addition through annual rolling plan. Mid-term review of national RA requirement planning shall be conducted to check for events of slippages by states, if any.

12.9. Based on allocated share in national peak demand provided in LT-NRAP, GRIDCO shall plan to contract capacities over and above the State coincident demand in national peak prescribed by LT-NRAP or procure higher to meet their Resource Adequacy Requirement (RAR) at the time of national peak.

12.10. GRIDCO may keep the share of Long-Term contracts at least 75-80% of the RAR and the rest to be met through Medium - Term contracts and Short-Term contracts.

Provided that power procurement through Day-Ahead Market (DAM), shall not be considered towards the contribution for meeting RAR.

12.11. GRIDCO may take inputs from the LT-NRAP like PRM, capacity credits, etc., while formulating their LT-DRAP and shall submit their plans to CEA by 30th September of each year for the ensuing year(s) for validation.

12.12. GRIDCO shall submit the LT-DRAP plan duly vetted by CEA along with necessary supporting documents and details for meeting RAR to the Commission within 15 days from the date of receipt of CEA's approval.

12.13. The Commission shall approve MT-DRAP and ST-DRAP of GRIDCO by 30th September of each year for the ensuing year(s) upon taking into consideration various scenarios as well as allocation of Resource Adequacy Requirement allocated to the State/GRIDCO/Distribution Licensee based on its contribution to the National peak or National RA requirement as determined by Authority or the NLDC or the ERLDC, as the case may be.

12.14. GRIDCO/ Distribution Licensees while formulating resource adequacy plans shall also consider the constraints mentioned in Annexure-I of these Regulations.

- 12.15. SLDC shall refer the approved ST-DRAP (Short Term Distribution Resource Adequacy Plan), for operational planning at the State level. The SLDC shall review the ST-DRAP on a daily, monthly and quarterly basis based on actual availability of generation resources and advice GRIDCO for necessary power procurement/planning.

Chapter 5

Power Procurement Planning

13. Procurement planning shall consist of;

- (a) Optimal power procurement resource mix,
- (b) Modalities of procurement type and tenure, and
- (c) Sharing of Capacity

14. Procurement Resource Mix

- 14.1. In power procurement strategy, GRIDCO shall ensure an optimal procurement generation resource mix and also facilitates smooth RE integration in its portfolio of power procurement resource options while meeting reliability standards and Renewable Purchase Obligation. Further, the future capacity mix may comprise of existing capacities, planned capacities and capacity addition required to meet the increasing demand of the utility considering appropriate gestation period of the generation resource.
- 14.2. For identification of the optimal generation procurement resource mix, optimization techniques and least-cost modelling shall be employed in order to avoid stranded capacity/ stranding of assets. GRIDCO shall engage in adoption of least cost modelling and optimization techniques and demonstrate the same in its overall power procurement planning exercise to be submitted to Commission for approval.
- 14.3. Procurement by GRIDCO shall be consistent with the identified resource mix and considering overall national electricity plan and policies notified by the Appropriate Government from time to time.
- 14.4. The power capacity procurement from renewable energy sources for fulfilling the RPO targets shall be carried out as per OERC (Procurement of Energy from Renewable Sources and its Compliance) Regulations, 2021 and amendments thereof.
- 14.5. The power procurement from Wind, Solar PV, Wind Solar Hybrid, Round the Clock (RTC) generations shall be carried out as per the guidelines for Tariff Based Competitive Bidding process notified by the Ministry of Power.
- 14.6. GRIDCO shall contract storage capacity corresponding to the results of MT- DRAP capacity addition requirement for future years from Battery Energy Storage System (BESS) and Pump Storage Projects (PSP) as per the guidelines for Tariff Based

Competitive Bidding process notified by the Ministry of Power. The sizing requirement for storage capacity should be determined on the basis of techno-economic modelling.

14.7. GRIDCO may contract power through Central Agencies/ Intermediaries/ Traders/ Aggregators in compliance with competitive bidding guidelines or through Power Exchanges/ agreements/ Banking arrangements with other Distribution Licensees.

14.8. GRIDCO may procure power on Short-Term and Medium-Term basis through DEEP and PUSHP portal or any other platform approved by MoP/ CERC.

15. Procurement Type and Tenure

15.1. GRIDCO, while determining the modalities and tenure of procurement of resource mix, shall ensure that at the initial level, available capacity within the region shall be optimized. For further optimization, procurement contract shall be decided first within the region subject to the least cost resource availability considering transmission constraints & cost of transmission for procurement from outside the region and then across regions if necessary.

15.2. GRIDCO shall identify the generation resource mix and also procurement strategy in Long-Term, Medium-Term and Short-Term horizon and seek approval of the Commission.

15.3. In its overall power procurement planning approach, GRIDCO shall lay greater emphasis on adequate contracting through Long and Medium-Term arrangements.

15.4. Assessment through Annual Rolling Plan shall ascertain incremental capacity addition requirement through Long-Term/Medium-Term/ Short-Term upon factoring in existing and planned procurement initiatives of GRIDCO. However, GRIDCO shall ensure that entering into new Long-Term and Medium-Term contracts does not contribute towards accumulation of stranded capacity and additional burden to the consumers on account of fixed cost associated with stranded capacity.

15.5. GRIDCO shall contract capacities by 30th November of each year and submit the Annual Rolling Plan to the Commission and SLDC& STU by 31st December of each year for ensuing year(s).

15.6. GRIDCO shall also demonstrate to the Commission 100% tie-up for the first year and a minimum 90% tie-up for the second year (on rolling basis) to meet the requirement of their contribution towards meeting national peak. Only resources with Long / Medium / Short-Term contracts shall be considered to contribute to the RA.

15.7. The Commission shall approve the Annual Rolling Plan by 15th January of each year for the ensuing year(s).

15.8. GRIDCO shall submit the state-level aggregated Annual Rolling Plan to RLDC by 20th January of each year for the ensuing year(s).

16. Approval of Power Purchase Agreement

16.1. Any new Capacity agreement/tie-up shall be subject to the prior approval of the Commission in view of necessity, reasonableness of cost of power purchase and promotion of working in an efficient, economical and equitable manner.

16.2. All procurement of Long/Medium/Short-Term power from various sources shall be carried out as per the Guidelines/Rules/Regulations/Policies issued by the Commission/ Central Government from time to time.

16.3. Any new power purchase agreement for Long/Medium-term or amendments to existing Long/Medium-Term Power Purchase Agreement (PPA)/ Power Sale Agreement (PSA) entered into by GRIDCO shall be subject to the prior approval of the Commission in respect of:

- (i) Necessity;
- (ii) Reasonability of cost;
- (iii) Promoting efficiency, economy, equitability and competition;
- (iv) Conformity with requirements of quality, continuity and reliability of supply;
- (v) Conformity with safety and environmental standards;
- (vi) Conformity with criterion of power purchase as laid down by the Commission;
- (vii) Conformity with policy directives of the State Government and policies issued by the Government of India viz. National Electricity Policy, Tariff Policy, Long-Term and Short-Term power procurement guidelines etc.

16.4. GRIDCO shall submit the list of all existing Power Purchase Agreements executed with different conventional power plants as well as RE Generators along with the Resource Adequacy plan.

17. Sharing of Capacity

17.1. GRIDCO shall duly factor in the possibility of Short-Term capacity sharing while preparing the Resource Adequacy plan and optimally utilize the platform for inter-state

capacity sharing or trading mechanism created by the Central Commission, and optimize the capacity costs as far as possible.

17.2. GRIDCO shall submit information about contracted capacity to the SLDC and the STU for compliance verification.

18. Variation in Power Purchase

18.1. GRIDCO may undertake additional power procurement during the year, over and above the approved resource adequacy procurement plan on account of following exemptions;

18.1.1. In case, where there has been an unanticipated increase in the demand for electricity or a shortfall or failure in the supply of electricity from any approved source of supply during the year or when the sourcing of power from existing tied-up sources becomes costlier than other available alternative sources, GRIDCO may enter into additional agreement for procurement of power with approval of the Commission.

18.1.2. GRIDCO may enter into a Short-Term arrangement or agreement for procurement of power when faced with emergency situations that threatens the stability of the grid, or when directed to do so by the SLDC/RLDC to prevent grid failure or during exigency conditions and for banking with other States on Short-Term basis without prior approval of the Commission.

Provided that the details of such Short-Term procurement shall be submitted to the Commission within 60days from date of procurement of power.

Chapter 6

Monitoring and Compliance

19. Monitoring and Compliance

19.1. **Monitoring and Reporting:** Based on the MT-DRAP and ST-DRAP, STU and SLDC shall communicate the state-aggregated capacity shortfall to the Commission by 30th September of each year for the ensuring year(s) and advise GRIDCO to commit additional capacities.

19.2. Treatment for shortfall in RA Compliance: GRIDCO shall comply with the RA Requirement and in case of non-compliance, appropriate non-compliance charge shall be applicable for the shortfall for RA compliance as determined by the Commission through a special order based on petition filed by the stakeholders. At the end of each Financial Year, SLDC shall submit the deviation in RAR plan from actual demand profile during that financial year to the Commission and also upload such details on its website.

Chapter 7

Roles and Responsibilities and Timelines

20. Data Requirement and Sharing Protocol

20.1. Distribution licensees shall maintain and share with STU/SLDC all data related to demand assessment and forecasting such as but not limited to consumer data, historical demand data, weather data, demographic and econometric variables, Distribution losses, actual electrical energy requirement and availability including curtailment, peak electricity demand and peak met along with changes in demand profile (e.g.: agricultural shift, time of use, etc.), historical monthly/ weekly/ hourly/ block-wise load shape (intervals as notified by the Commission from time to time), etc.

20.2. Distribution Licensee shall maintain all statistics and database pertaining to policies and drivers, such as LED penetration, efficient fan penetration, appliance penetration, increased usage of electrical appliances for cooking, etc., in households, increase in commercial activities for geographic areas/regions, increase in number of agricultural pumps and solarization within control area, changes in specific energy consumption, consumption pattern from seasonal consumers such as tea plants, Demand Side Management (DSM) and Distributed Energy Resources (DERs), Electric Vehicles (EVs) and Open Access (OA), National Hydrogen Mission, reduction of AT&C losses, etc. shall also be shared.

20.3. Distribution Licensee shall maintain at least past 10 years of statistics in its database pertaining to consumption profiles for each class of consumers segregating voltage wise category, such as domestic, commercial, public lighting, public water works, irrigation,

LT industries, HT industries, railway traction, bulk (non-industrial HT consumers), open access, captive power plants and insights from load survey, contribution of consumer category to peak demand, seasonal variation aspects, etc.

20.4. SLDC shall maintain the licensee-specific as well as aggregate for state as whole, the statistics and database pertaining to aggregate demand assessment and forecasting data mentioned above and share state-level assessment with the Authority and the NLDC for regional/national assessment from time to time.

20.5. GRIDCO shall share information and data pertaining to the existing and contracted capacities with their technical and financial characteristics with SLDC. SLDC shall consider monthly generation profile for computation of state-level Capacity Credit factors and for preparation of state-level assessment.

21. Timelines

Sl. No.	Target Date	Activity
1	30 th April	Distribution Licensee shall submit monthly Short-Term (ST), Medium-Term (MT) and Long-Term (LT) forecasts to SLDC.
2	31 st May	SLDC shall submit the state-level aggregate demand forecasts (MW and MWh) for LT, MT and ST to the Authority, NLDC, ERLDC, GRIDCO and STU
3	15 th May	GRIDCO shall share CC factors for their contracted resources along with justification for its computations with SLDC
4	31 st May	SLDC shall calculate state-specific CC factors submit to the Authority, NLDC and ERLDC
5	31 st August	GRIDCO shall submit MT-DRAP and ST-DRAP to the Commission, STU and SLDC
6	30 th September	Commission shall approve MT-DRAP & ST-DRAP SLDC and STU to communicate state aggregate capacity shortfall to Commission GRIDCO shall submit LT-DRAP to CEA
7	30 th November	GRIDCO shall contract capacities for each year
8	31 st December	GRIDCO shall submit the Annual Rolling Plan to the Commission and SLDC
9	15 th January	Commission shall approve the Annual Rolling Plan
10	20 th January	GRIDCO shall submit the state-level aggregated Annual Rolling Plan to ERLDC

Chapter 8

Miscellaneous

22. Power to Give Directions

The Commission may from time to time issue such directions and orders as considered appropriate for implementation of these Regulations.

23. Power to Relax

The Commission may by general or special order, recording reasons in writing, may relax any of the provisions of these Regulations on its own motion or on an application made before it by an interested person.

24. Power to Remove Difficulties

If any difficulty arises in giving effect to the provisions of these Regulations, the Commission may, by an order, make such provisions, not inconsistent to the provision of the Act and these Regulations, as may appear to be necessary for removing the difficulty in giving effect to the objectives of these Regulations.

25. Power to Amend

The Commission, for reasons to be recorded in writing, may at any time vary, alter or modify any of the provisions of these Regulations by an amendment.

26. Interpretation

If any question arises relating to the interpretation of any provision of these Regulations, the decision of the Commission shall be final.

By Order of the Commission
Dr. PRIYABRATA PATNAIK
SECRETARY

ANNEXURE -I

Methodology of Preparation of Resource Adequacy Plan with constraints

After establishment of demand profile for all future years, the model would be undertaken for an optimization exercise to minimize the total system cost to meet the future demand adhering to all power system parameters. Following constraints should be considered while modelling.

Planning Reserve Margin / Resource Adequacy Requirement:

The Resource Adequacy Requirement (RAR) constraint shall ensure that the total Resource Adequacy (Generation Capacity) of the Distribution Licensees/ GRIDCO fulfills the Planning Reserve Margin as determined by CEA. The resource adequacy requirement shall be computed as:

$$\text{RAR} = \text{Contribution to forecasted national peak demand in GW} \times (1 + \text{PRM})$$

From the supply side, the RAR shall be the sum of the “firm capacity” or “Capacity Credits” of contracted/ planned capacities (including renewables, storage, other sources such as demand response) along with derated interconnection limits.

The firm capacity shall be calculated as provided in Annexure-II of these regulations.

GRIDCO shall use these capacity credits while planning to meet their RAR. For example, GRIDCO having a PPA with an existing solar based power plant located in a southern State would use the Capacity Credit of existing solar based power plants in the Southern Region.

Portfolio balance constraints:

The portfolio balance constraints shall ensure that the total generation and the import of power to the state is equal to the sum of the demand, exports from the state, any energy not served and curtailment, for each hour.

RE Generation constraints:

For renewable resources, such as solar and wind, the RE generation constraints shall be constrained as per the monthly profile of the resource. Historic profiles of renewable sources shall be used to generate the monthly profiles. Additional constraints shall ensure that the distribution licensees overall renewable generation targets are met and included while formulating LT-DRAP.

Conventional Generation constraints:

- (a) Unlike solar and wind, thermal resources are dispatchable. However, the thermal resources are bound by constraints such as maximum and minimum generation limits, ramp rates, spinning reserve offers, plant availability and unit commitment decisions.

- (b) The dispatch (energy offer) plus the reserve offer (specified through regulations) for each generator is constrained to be within the maximum and minimum generation limits. Generation between two consecutive time blocks also must be within the ramping capabilities of the resources. Unit commitment decisions, such as start-up/shut-down, minimum up and down times, etc., require binary variables to implement and are to be included. Additionally, generation units may have periods of outages which may need to be captured by using an availability factor.
- (c) The capacity for each year needs to be tracked by a constraint which shall ensure that the capacity in a particular year is equal to the capacity last year plus any new capacity investment minus capacity retirement, if any.

RPO constraints:

Fulfilment of Renewable Purchase Obligation shall be considered as one of the objectives of Resource Adequacy. Technology options like renewable generation for round the clock energy supply backed with storage (Battery and PSP), standalone renewable capacity along with hydro capacity for balancing renewable generation shall be considered while carrying out resource adequacy exercise.

Storage constraints:

Due to the intermittent nature of renewable generation, the need for resources which can store surplus energy and despatch the stored energy during low RE periods becomes vital. Storage charge and discharge at any instant are constrained by the storage level or the State of Charge (SoC) of the storage resource, and the maximum charge / discharge limit. The resource shall only discharge if there is sufficient energy present during prior charging of the resource. To implement this, considering the chronological sequence of time is also important. Since storage resources convert electricity to other forms of energy, there are also some efficiency losses (round-trip efficiency) which shall be accounted for. Different technologies may have different discharge periods (energy limits), power outputs (maximum charge / discharge) and levels of efficiency.

Operating (Spinning) Reserve constraints:

Operating reserve constraints shall ensure that sufficient resources are in the system and kept online or on standby each hour to account for load forecast errors, intermittency of renewables or meeting contingencies in the real time. The thumb rule for operating reserve requirement shall be defined based on discussions with the SLDC and shall be considered as an input parameter to the model.

Demand Response:

Potential for demand side management such as shifting of load or demand response can be considered while undertaking the Resource Adequacy Plan (RAP). The constraints such as periods when load shifting can occur, and the maximum quantum of load which can be shifted over a period shall be included.

Annexure-II

The firm capacity to meet the Resource Adequacy Requirement (RAR) shall be calculated as shown below:

RAR=

$$\begin{aligned} & \sum_{i=1}^{num_solar} (Solar_Capacity * Solar_Capacity_Credit) \\ & + \sum_{i=1}^{num_wind} (Wind_Capacity * Wind_Capacity_Credit) \\ & + \sum_{i=1}^{num_hydro} (Hydro_Capacity * Hydro_Capacity_Credit) \\ & + \sum_{i=1}^{num_thermal} (Thermal_Capacity * Thermal_Capacity_Credit) \\ & + \sum_{i=1}^{num_nuclear} (Nuclear_Capacity * Nuclear_Capacity_Credit) \\ & + \sum_{i=1}^{num_storage} (Storage_Capacity * Storage_Capacity_Credit) \\ & + \sum_{i=1}^{num_other} (Other_Resource_Capacity * Other_Resource_Capacity_Credit) \\ & + \sum_{i=1}^{num_other} (Import_limit * Capacity_Credit) \end{aligned}$$